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JOHNSONGRASS

...as a weed

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JOHNSONGRASS . . . AS A WEED

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Johnsongrass, *Sorghum halepense* (L.) Pers., is native to the Mediterranean region, and was introduced to the United States around 1800 for use as a potential forage crop. By 1840, it was growing in several southeastern States, and by the late 1800's, it had been planted throughout much of the United States including Montana, Michigan, South Dakota, Wyoming, Iowa, Nebraska, and California.

In 1900, the U.S. Department of

[1] Former editions were prepared by Ellis W. Hauser and H. Fred Arle, Agronomists.

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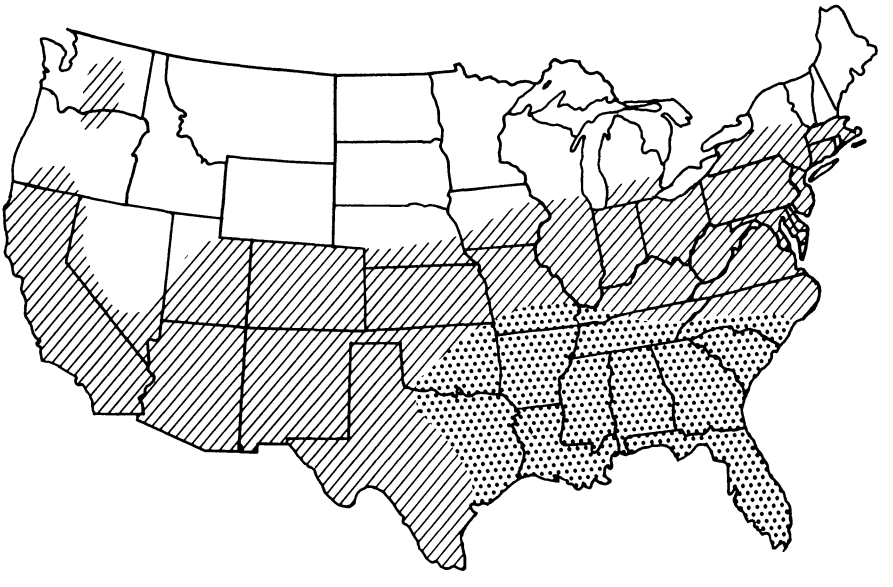

Figure 1.—General distribution of johnsongrass in the United States. The denser hatching over the Southeastern States indicates the area where johnsongrass is of greatest economic importance.

Agriculture launched the first organized weed control program against johnsongrass. Initial goals were to develop cultural methods to control this weed. More recently, intensive efforts have been made to develop chemical and combination chemical-cultural methods.

Johnsongrass is one of the 10 worst weeds in the world. This weed competes with a variety of crops for nutrients, water, sunlight, and air. It spreads to distant areas by seed and in local areas by both seed and rhizomes. Johnsongrass produces hard seed which may continue to germinate for several years.

Within a few years after johnsongrass becomes established, the soil is usually heavily infested with rhizomes and seed. For example, in Louisiana, johnsongrass produced 7 tons of rhizomes per acre in the row area of a sugarcane field. Also, johnsongrass can produce up to 10 bushels of seed per acre.

GROWTH HABITS

Johnsongrass is an erect, perennial plant that grows to a height of 3 to 10 feet. It is adapted to a wide variety of soils including upland clays, but it grows best on porous, fertile lowlands. Various parts of a johnsongrass plant are illustrated in figure 2.

Johnsongrass seed and foliage look like that of sudangrass, an annual grass used widely for grazing and hay. However, the seeds of these two grasses can be identified by differences in structures of the pedicel, the short stalk of the seed that joins the seed to the seedhead. On johnsongrass seed, the tip of the pedicel is knobshaped; on sudangrass, the tip of the pedicel is rectangular. Another difference is that sudangrass reproduces only from seed; johnsongrass reproduces from seed and rhizome.

Johnsongrass also resembles sorghum almum, *Sorghum almum* Parodi, a plant grown for grazing or hay but occurring as a weed in sorghum fields and subsequent crops. This plant produces less rhizome growth than johnsongrass and grows to a height of 6 to 12 feet. Fortunately, it is easier to control than johnsongrass. Treatments that control johnsongrass are also effective for sorghum almum.

Methods of Propagation

Johnsongrass seedlings usually begin to develop rhizomes within 3 to 4 weeks after emergence. Seedlings continue to emerge throughout the growing season. Growth of seedlings is especially troublesome in flooded bottom lands, because each overflow can bring in new seeds. In these areas, new seedlings continually present serious problems even if established johnsongrass is effectively controlled. Seeds can remain dormant in the soil for years before germination. For effective control of johnsongrass, seedlings must be killed as well as established plants.

Johnsongrass also reproduces and spreads from rhizomes. These underground stems are produced most extensively after johnsongrass forms seedheads. After flowering, a single johnsongrass plant may

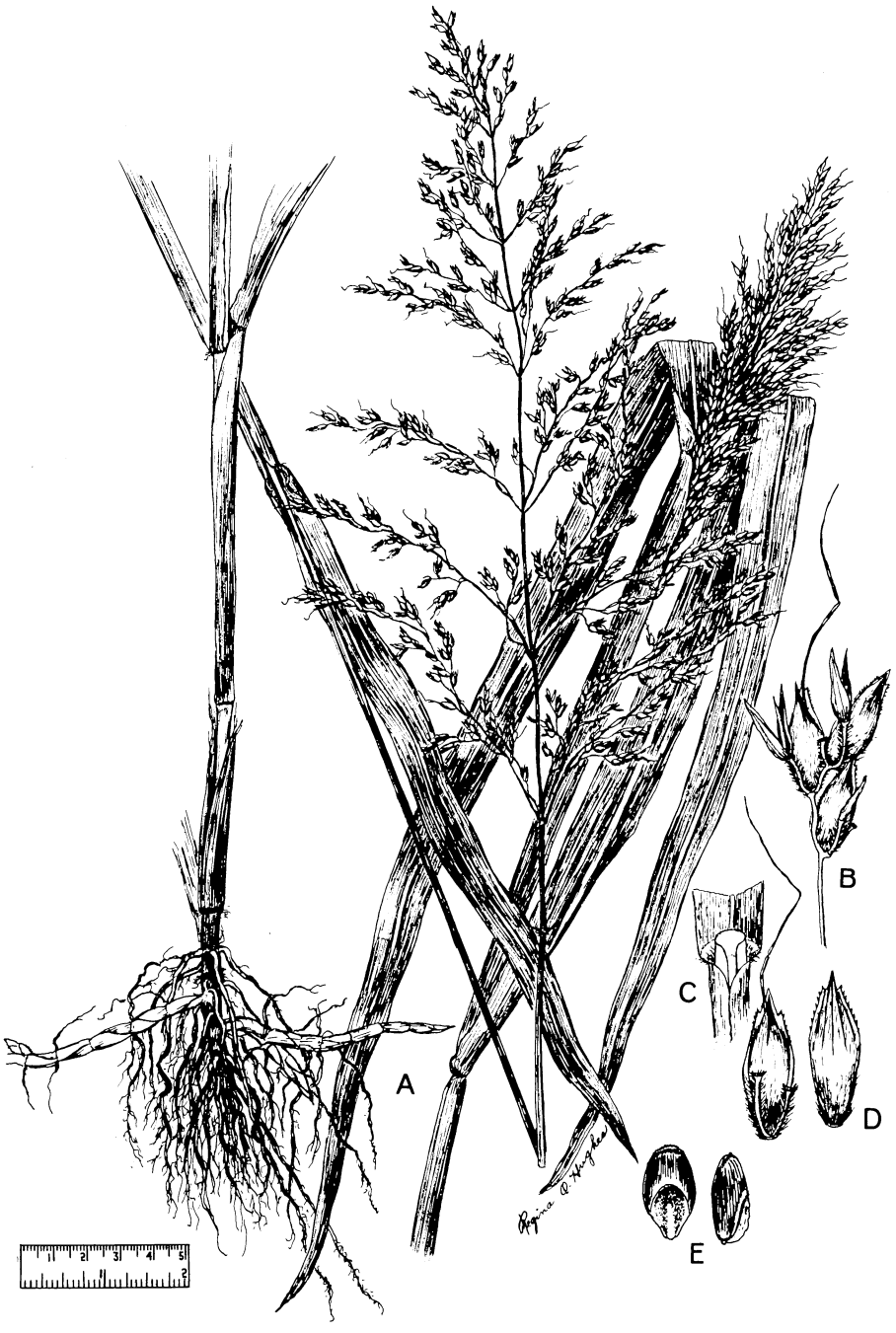

Figure 2.—*Sorghum halepense* (L.) Pers. Johnsongrass. *A*, Habit—× 0.5; *B*, spikelet—× 4; *C*, ligule—× 1.5; *D*, florets—× 5; *E*, caryopses—× 5.

produce 200 to 300 feet of rhizomes in one month (see fig. 3).

Rhizomes produced early in the growing season may die in the fall or winter. Those produced late in the growing season usually survive the winter to produce johnsongrass plants the following spring. Even a small rhizome fragment with a single bud may sprout to produce a new plant. Johnsongrass may also be propagated from old aerial- or above-ground stems when they are plowed under into moist soil.

Influences on Rhizome Growth

Many conditions, including moisture, soil type, cultivation, and cropping systems, influence the growth of rhizomes, the depth of rhizome penetration, and the amount of food stored by these underground stems.

Soil type affects the growth of johnsongrass rhizomes. If moisture and nutrients are not limiting factors, rhizomes will penetrate deeper in porous soils than in compact clays. Yet, deep penetration may occur when clays form cracks under dry conditions. Rhizomes may grow downward through cracks to a depth of 2 to 3 feet.

More vertical and linear rhizome growth will occur in deeply plowed soils than in unplowed soil in the same type under the same moisture conditions. Also, they will commonly grow to a depth of 10 to 20 inches if soil is not compacted.

Approximately 90 percent of the annual rhizome production occurs

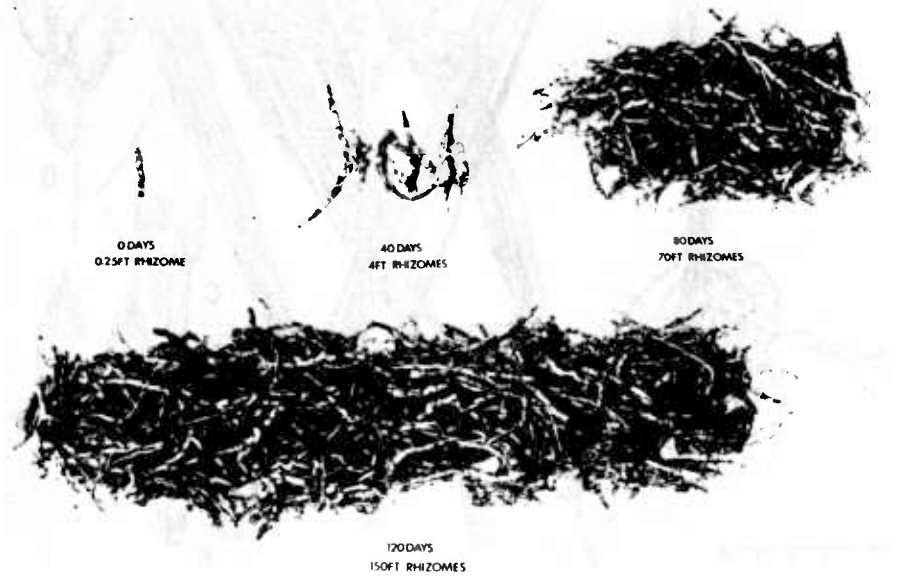

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Figure 3.—Johnsongrass rhizomes produced by plants started with a 0.25 foot rhizome section at Stoneville, Miss. The 600-fold increase in rhizomes in 120 days would be accompanied by the production of several pounds of seed.

after johnsongrass plants have flowered. Rhizome growth can be substantially reduced if johnsongrass is not allowed to exceed a height of 12 to 15 inches. Height can be kept to a minimum by mowing or grazing throughout the season.

Good crop cultivation in early season is effective in controlling johnsongrass, especially if a large portion of the rhizomes is uprooted and dried by exposure to sunlight or wind. Poor cultivation, however, can actually encourage rhizome growth by helping to distribute rhizomes and by loosening the soil, making it an ideal seedbed for johnsongrass growth.

Whether control measures are effective for established johnsongrass depends mostly on rhizome development. For example, the grass is much easier to control in closely grazed pastures, where rhizomes penetrate only to shallow depths, than in fields of row crops where extensive rhizomes develop.

CONTROL WITH CULTURAL METHODS

The objectives of any good cultural program are: (1) To weaken and kill existing plants and their attached rhizomes and to prevent formation of new rhizomes; (2) to control seedlings and deplete the population of seed already present in the soil; and (3) to prevent production of seed.

Crop Rotation

Proper crop rotation will reduce losses caused by a moderate infestation of johnsongrass. Any crop rotation that provides adequate competition for johnsongrass topgrowth and limits development of rhizomes will also aid in controlling this weed.

Soybeans and cotton compete with johnsongrass better than corn or sorghum. In addition, more effective herbicide practices for johnsongrass control are available for soybeans and cotton than for some other crops.

Certain soybean varieties are better competitors to johnsongrass than other varieties. The more competitive varieties produce higher yields than less competitive varieties when moderate to heavy stands of johnsongrass are not controlled.

The effectiveness of crop rotation for johnsongrass control also depends on the management of each crop. The intensive cultivation and other cultural practices normally used in vegetable production often eradicate established johnsongrass. Good stands of all crops are essential because poor stands cannot compete effectively with johnsongrass.

In the Southwest, an effective crop rotation consists of 2 to 4 years of alfalfa, 2 years of cotton, and 1 or 2 years of a small grain. Another row crop is often substituted for cotton. Use of a small grain during the winter preceding fallow plowing has been effective in both the South and Southwest.

Crop rotations may not eliminate all johnsongrass but good control can be obtained by spot treatment with herbicides. Regardless of the rotation, johnsongrass should be controlled around field edges to prevent spread into the crop area.

Fallow Plowing or Disking

Mechanical cultivation during the growing season often provides the best control for general infestations of johnsongrass. It is most successful in drier areas. Fallowing land for a season does not always control all johnsongrass, but it can reduce a general infestation to a few plants per acre. The remaining plants are controlled or destroyed through crop rotation or use of herbicides.

Moldboard plows, disk plows, or field cultivators with flat sweeps are used for fallow plowing. In the Southwest, moldboard plows have been more effective than disk cultivators.

Maximum control is obtained when fields are cultivated every 4 to 5 weeks to remove top growth and expose rhizomes to drying. In the Southeast, alternate usage of field cultivators equipped with flatsweeps and disk cultivators is slightly more effective than continuous use of either implement alone. Disking cuts rhizomes into smaller pieces and increases dehydration. Field cultivators tend to bring more rhizomes to the soil surface.

Rod-weeders also are highly effective to control rhizome johnsongrass in summer fallow. These implements are equipped with a rod mounted behind field cultivators so that rhizomes are pulled to the soil surface.

In most areas six to eight fallow plowings during the spring and summer are effective for johnsongrass control, but proper timing of plowing is necessary for best results. Cultivation is most effective when grass is about 14 inches tall. This helps prevent plants from forming rhizomes or seeds.

Under conditions of the lower Mississippi River Valley, six to 10 disk cultivations are effective in controlling johnsongrass, when applied in a 4- to 6-week period in the spring. This intensive disking in the early growing season permits production of a soybean crop after the brief fallow period. The treatments are most effective under dry conditions.

Pasturing and Mowing

Pasturing has long been recognized as a method of keeping johnsongrass under control. Pasturing also makes the weed more susceptible to other treatments.

Close grazing for two or more seasons makes johnsongrass plants weak or stunted and causes the development of small rhizomes near the soil surface. Over a period of years, pasturing will reduce the stand considerably.

If plants attain a height of more than 12 to 15 inches, clipping reduces rhizome development and seed formation. To increase crop yield on pastureland, let the pasture fallow for the summer, then disk or plow it the following year before planting.

Mowing usually has a similar effect on johnsongrass as grazing, but it is less effective than disking. Disking five to seven times during the summer controls johnsongrass better than six to 10 mowings.

Other Cultural Methods

Geese have sometimes been used to control johnsongrass in cotton.

The geese selectively eat young grass leaves without injuring the cotton. They have, however, been of limited value on large farms because of the difficulty in watering and other management problems.

Johnsongrass is also controlled with flooding. In Arkansas and Mississippi, best results are obtained when fields are covered with 3 to 4 inches of water before johnsongrass rhizomes germinate in early spring. Best results are produced when water is kept on the infested area for 3 to 6 weeks during the period that johnsongrass usually germinates.

If properly fertilized and managed, alfalfa provides good direct competition for moderate stands of johnsongrass. The frequent clipping of alfalfa for hay tends to restrict the development of johnsongrass rhizomes.

It is easier to control johnsongrass over an entire farm if unnecessary ditches are filled, and if culverts or pipes can be used to replace open ditches. Banks of unfilled ditches should be leveled so they can be mowed or disked. Leveling also facilitates application of herbicides with tractor equipment although uneven areas can be treated with power sprayers. (See fig. 4.)

In the Southwest, butane-propane burners provide effective control of johnsongrass along canals. These burners have a temperature of approximately 3,000° F. at the burning point. Best control is obtained when burning is conducted on a 2-week schedule throughout the growing season. Usually no regrowth occurs on the area the following season although control is often better on canals lined with concrete or plastic than on unlined canals.

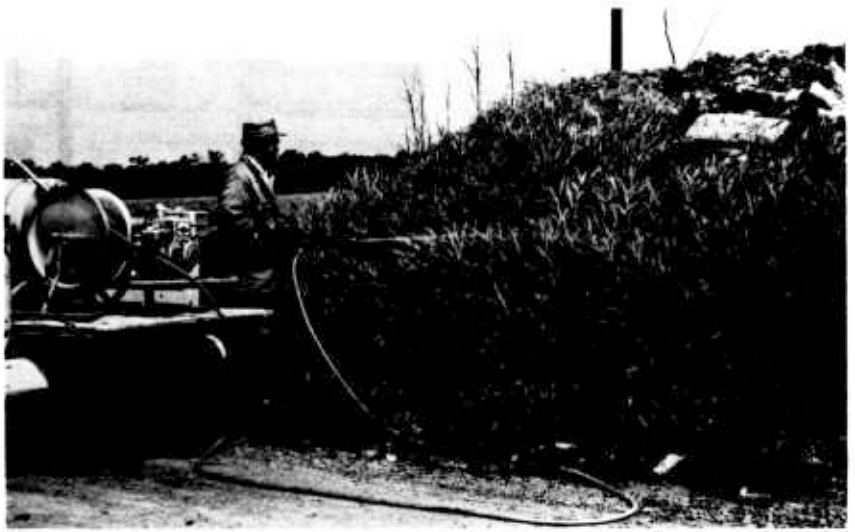

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Figure 4.—Portable sprayers are effective in applying both soil sterilants and foliar-applied herbicides to johnsongrass in the more inaccessible areas.

CONTROL WITH CHEMICALS

Many herbicides successfully control johnsongrass. The performance of these herbicides is affected by soil type and weather conditions. Consult your local agricultural experiment station or county agricultural agent before you purchase the herbicides.

Residual Herbicides

Sodium chlorate effectively controls johnsongrass on noncropland (fig. 5). The effectiveness of sodium chlorate depends primarily on the soil texture and the amount of rainfall after application. Chemical action takes place principally through the soil. Control is effective only if rainfall is sufficient to move the chemical into the zone containing the greatest concentration of johnsongrass roots. Usually this sterilant renders the soil unproductive for 6 months to 3 years depending on dosage, soil texture, and amount of rainfall after application.

The effective dosage of sodium chlorate varies from 100 pounds per acre on sandy soil to 600 pounds per acre on clay. Plants that escape the initial treatment often spread unless retreated.

Sodium chlorate is corrosive to many metals and creates a severe fire hazard when combined with flammable materials such as clothing, hay, wood, or weeds that have been wet with the spray. Smoking in recently treated areas can ignite recently treated vegetation. Use of a formulation that contains a fire retardant will greatly reduce the fire hazard. One fire-retarding solution consists of 1 pound of calcium chloride with each 2 pounds of sodium chlorate used in solution.

Sodium trichloroacetate (usually known as TCA) satisfactorily con-

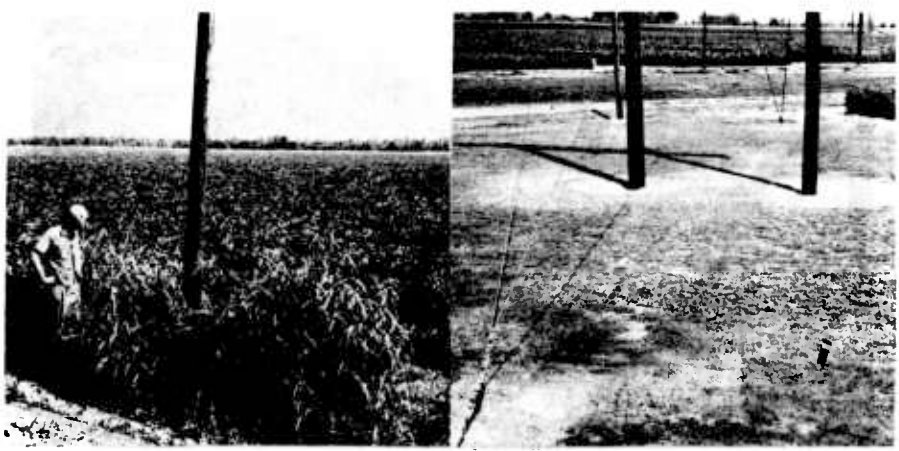

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Figure 5.—Johnsongrass around poles near fields (on the left) provides a continuous source of seed and rhizomes to reinfest fields. It can be controlled in these areas with soil sterilants such as sodium chlorate (on the right).

trols johnsongrass on noncropland. The effective rate of TCA varies from 40 to 200 pounds per acre. To be most effective, it must be leached into the soil by rainfall. TCA remains active in soil 1 month to 2 years depending on soil texture, temperature, and rainfall after treatment.

Many other herbicides give residual control of johnsongrass. Examples of residual herbicides in different chemical families include:

- Uracils: bromacil (5 - bromo - 3 *sec*-butyl-6-methyluracil).
- Triazines: prometone [2,4 - bis (isopropylamino) - 6 - (methylthio) - s - triazine].
- Ureas: monuron [3 - (p - chlorophenyl) - 1,1 - dimethylurea].
- Borates: borax (sodium tetraborate).

Herbicides with residual activity control johnsongrass from 1 to 5 years depending on soil texture and climate (fig. 6). Control will be lessened unless they are leached into the root zone to provide maximum control. Applications in fall or early spring normally provide best control. Mechanical incorporation of these herbicides into the soil will reduce lateral movement of the herbicides from the treated zone.

Contact Herbicides

In Arizona, herbicidal oils effectively control johnsongrass on ditchbanks and on noncropland. The most effective are undiluted aromatic oils that have the following specifications: A.P.I. gravity—Maximum, 20°; Initial boiling point—400° F.; End point—700° F.; Aromatics—Minimum, 65 percent; Interfacial tension—5 dynes per centimeter.

The total amount of oil for control during one season ranges from 500 to 725 gallons per acre. Up to 160 gallons per acre are used during each application. Each treatment is made before johnsongrass reaches a height of 12 inches. Repeat applications are timed for maximum control of established plants. The rate of oil applied per acre is reduced in mid- to late-season as the stand of johnsongrass is reduced.

Foliar applications of paraquat (1,1′-dimethyl - 4,4′ - bipyridinium ion) control johnsongrass in more than 25 crops and on noncropland. Paraquat is applied at 0.5 to 1.0 pounds per acre in water at 20 to 40 gallons per acre to johnsongrass plants before they are about 14 inches tall. It provides little control of the underground system of roots and rhizomes.

Translocatable Foliage Sprays

The sodium salt of dalapon (2,2-dichloropropionic acid) is effective as a foliage spray for grass control in more than 20 crops and on noncropland. Many fruit, nut, and field crops will tolerate preplanting treatments, spot treatments, or selectively placed applications of dalapon that are effective against johnsongrass. Dalapon is absorbed by johnsongrass foliage and translocated to underground roots and rhizomes where it prevents growth.

It is effective when applied at 2.0

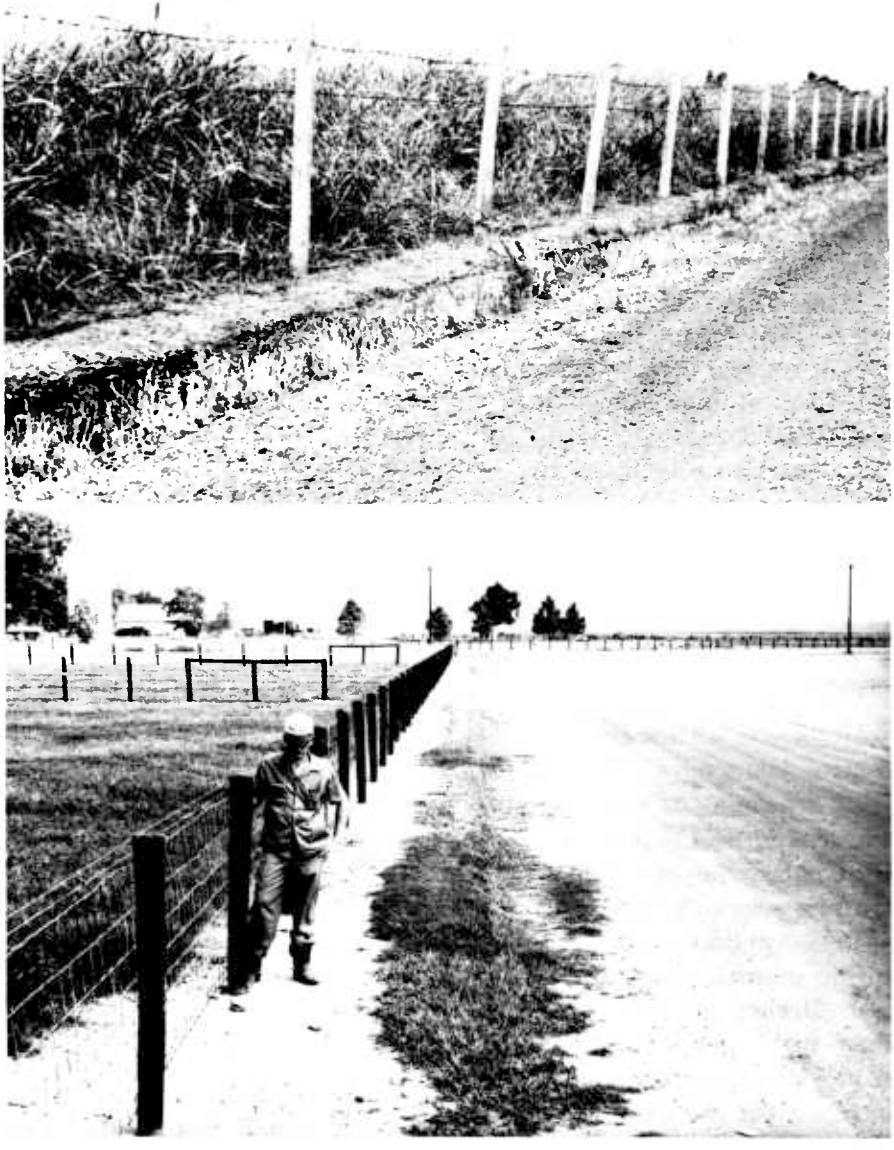

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Figure 6.—In the upper photograph johnsongrass was effectively controlled (to the right of the fence) with foliar applications of MSMA. In the lower photograph, excellent control is still provided under the fence 2 years after a spring application of bromacil (5-bromo-3-sec-butyl-6-methylurea) at 20 lb/A.

to 7.5 pounds of active chemical per acre in water at 10 to 20 gallons per acre. However, there are limitations as to the exact rate, method, time, and frequency of application that can be tolerated by different crops without significant injury. Contact your county agricultural agent or State agricultural experiment station concerning limitations on its use.

The most effective control is obtained when dalapon is applied to actively growing johnsongrass before seedhead formation. Dalapon is broken down rapidly in soil.

DSMA (disodium methanearsonate) at 3 pounds per acre or MSMA (monosodium methanearsonate) at 2 pounds per acre in water at 20 to 40 gallons per acre applied as foliage sprays are highly effective for johnsongrass control in cotton. MSMA is also effective for johnsongrass control on ditchbanks and on noncropland.

One or two postemergence applications are effective when applied to johnsongrass as directed sprays after cotton is 3 to 4 inches tall, but before the first bloom appears. Directed sprays are obtained by pointing nozzles so that spray fans wet weeds underneath crop plants but does not contact cotton leaves. Application to the foliage, or any type of application after the first bloom appears, may reduce cotton yields or cause an increase in the arsenic content of the cottonseed.

MSMA provides effective control on drainage ditchbanks (fig. 4) although it should not be sprayed into water. Both DSMA and MSMA are most effective when reapplied for maximum johnsongrass control. More johnsongrass regrowth is expected following treatment with arsenicals than with dalapon.

Best control with DSMA or MSMA is often obtained under hot, droughty conditions as contrasted to control with dalapon, which is usually best with moist conditions. As a result, growing conditions at time of treatment are often used as a basis to determine which herbicide will be most effective.

COMBINATION CONTROL METHODS

Preplanting Treatments

Dalapon provides significant control when applied to johnsongrass foliage before planting several crops including cotton, corn, sorghum, and soybeans. The crops normally are not affected by the treatment if sufficient time elapses between application and planting of the crop.

Cultivation of treated fields within a few days after applying dalapon speeds the dissipation of the herbicide. Ordinarily, crops planted within a few days or weeks are not affected by the treatment. These treatments can be highly effective for johnsongrass control but usually some plants will escape unless follow-up treatments are made (fig. 7).

Preemergence Treatments

Herbicides are frequently applied as preemergence treatments to the soil before weed and crop emergence, usually before or immediately after planting. Many preemergence

treatments provide excellent control of johnsongrass seedlings but will not control established johnsongrass. Control of plants from seed is essential in a total-control program, because new seedlings present a continuing problem where established johnsongrass has been effectively controlled.

There are approximately 12 her-

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Figure 7.—Acceptable control of johnsongrass in cotton (left side of upper photo) and soybeans (left side of lower photo) is usually the combined result of tillage and herbicides applied both preplanting and preemergence. Herbicides applied post-emergence or by hand labor may be needed to control escapees even when combined practices are used.

bicides, tolerated by a number of crops, that will control johnsongrass seedlings. These herbicides will be effective when applied as preemergence treatments. Some are applied to the soil surface; others are mechanically incorporated into the soil. Mechanical incorporation of some chemicals increases their effectiveness and reduces rainfall requirement for activity. Some herbicides are rapidly lost by vaporization or photodecomposition. Herbicides applied to the soil surface usually do not control johnsongrass seedlings unless leached into the soil by rain or sprinkler irrigation.

Research in Mississippi has shown that if trifluralin (*a,a,a,*-trifluoro-2,6-dinitro-*N,N* - dipropyl-*p*-toluidine) is applied at the maximum registered rate, it is the most effective means of controlling johnsongrass from both rhizomes and seed in soybeans (see fig. 8). Trifluralin is normally used to control johnsongrass from seed and annual weeds at 0.5 to 1 pound per acre on sandy to clay soils. Johnsongrass from rhizomes is also controlled when trifluralin is applied at 1 to 2 pounds per acre on sandy to clay soils. The herbicide must be thoroughly incorporated into the soil, and treatment usually must be applied for two consecutive years to effectively control johnsongrass from rhizomes in soybeans.

Trifluralin at 1 to 2 pounds per acre may often provide good to excellent johnsongrass control on sandy loam soils in the first year, but only poor to fair control on clays. After 2 years, johnsongrass control is usually good to excellent regardless of soil type. Many plants may grow from rhizomes during the first year's use, but subsequent rhizome production by these plants is greatly reduced as a result of trifluralin treatment, even though the above-ground growth of johnsongrass appears normal. Reduced rhizome production during the first year of treatment is often not apparent until the second growing season, when reduced johnsongrass regrowth is evident.

It is important that trifluralin be applied again in the second year at the maximum registered rate of 1 to 2 pounds per acre to provide further reduction in rhizome populations and maximum control of seedling johnsongrass.

Maximum control is obtained when trifluralin is applied broadcast. The herbicide is applied in water with either ground or aerial equipment in fall or spring.

Best control is obtained when the herbicide is applied to cultivated soil free of vegetation, and is thoroughly incorporated into the soil within 4 hours after application. If the trifluralin is applied to a wet, warm soil surface, or if the wind velocity is 10 mph or higher, it is especially important to work the herbicide into the soil quickly, otherwise some of its effectiveness may be lost.

Disk cultivation usually provides the most economical means of incorporating trifluralin into the soil. The disk cultivator should be adjusted to penetrate at least 3 to 4 inches deep, and the treated area should be disked twice. The second

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PN-3317

Figure 8.—On the left, johnsongrass was controlled on this sandy loam soil by applying trifluralin at 1.0 pound per acre over a period of 2 years. The plot on the right did not receive herbicide treatment.

disking should be at a right angle to the first.

The purpose of applying the herbicide to freshly cultivated soil and then disking twice is to achieve thorough and uniform incorporation. The machinery used for incorporation should break up large clods, so that the trifluralin will uniformly mix with the soil. On compacted soils, thorough incorporation of trifluralin is usually improved if the field has been chisel-plowed before the herbicide is applied. Chisel plowing also breaks johnsongrass rhizomes, which aids in providing maximum control.

After trifluralin has been used at the maximum registered rate for two consecutive years to control johnsongrass from rhizomes, suitable preemergence herbicides should continue to be used in the conventional manner to control johnsongrass seedlings.

Postemergence Treatments

Herbicides effectively control johnsongrass in cotton after the crop has emerged. Directed postemergence applications of herbicidal oil, DSMA, or MSMA control seedling and established johnsongrass in cotton if adequate coverage of johnsongrass is obtained. These treatments cause less damage if the sprays are kept off the cotton foliage.

Johnsongrass that has escaped previous treatment is often controlled with spot treatment of herbicidal oil, dalapon, or TCA ester [ethylene glycol bis(trichloroacetate)]. These are applied with tractor, knapsack (fig. 9) or gravity flow sprayers. These treatments are most effective on thin stands of johnsongrass.

Spray solutions of dalapon for spot treatments are prepared by mixing 0.74 pound of active chemical per 10 gallons of water. Sprays of this material are often applied to johnsongrass up to three times during the growing season. TCA ester is applied by diluting 2 pounds of active TCA to 10 gallons with No. 2 fuel, diesel, or other related oil.

In soybeans, directed applications of herbicidal oil are effective for killing seedling johnsongrass and for suppressing growth of established johnsongrass. Plants that escape these and previous treatments are controlled with spot applications of TCA ester as described above.

River bottoms or flood plains usually contain numerous seeds and rhizomes. Reinfestation is most severe in the area southward from the 40th parallel which includes the flood plains soils of Ohio, Indiana, Illinois, Iowa, and Missouri. Practices that are effective for control of johnsongrass on these flooded soils are:

(1) Keep the johnsongrass below a height of 12 inches until late June by pasturing or cutting for hay.

(2) Apply dalapon at 5 to 7 pounds per acre.

(3) Wait 2 weeks and plow.

(4) Plow and disk thoroughly every 2 weeks until about September 15, keeping the soil worked so that the johnsongrass does not exceed a height of 6 to 8 inches.

(5) Plant a winter grain crop in the fall.

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Figure 9.—Spot treatment of johnsongrass in a cotton field with a pressure-knapsack sprayer. Care should be taken to direct herbicide sprays away from the crop.

(6) Plow the following May, plant to soybeans or corn, apply a suitable preemergence herbicide, and cultivate thoroughly to control johnsongrass seedlings and discourage rhizome development.

Somewhat better control of very dense johnsongrass stands has been obtained by following steps (1), (2), (3), (4), then sowing a winter grain crop as in step (5), and then harvesting the grain crop the next summer. Steps (2), (3), and (4) are repeated throughout the second summer and a winter grain crop sown. Soybeans or corn are grown the third summer. These practices often permit soybean or corn production a second year if the scattered johnsongrass plants that remain are rogued.

Johnsongrass control is an essential part of a complete sugarcane production program. Fallow cultivation is essential for its control in addition to the use of one or more herbicides.

Fallow plowing for sugarcane begins in the spring and is repeated whenever johnsongrass plants are about 10 inches tall. Six or more plowings are usually needed throughout the growing season. Late fall or winter plowing following early harvested stubble sugarcane has little effect in killing johnsongrass rhizomes or in germinating johnsongrass seed in the soil.

The herbicides used for weed control in sugarcane depend on the program selected. Approximately eight different herbicides are used in Louisiana for controlling johnsongrass in sugarcane, depending on whether the sugarcane is newly planted or stubble cane. The final program selected also depends on whether or not the sugarcane has been shaved and off-barred. Because of the complexity of johnsongrass control in sugarcane, contact an agricultural authority in your area for current recommendations.

GENERAL SUGGESTIONS FOR CONTROL

Before control measures for johnsongrass are initiated, consult local agricultural authorities because results with different practices and herbicides vary under different soil and climatic conditions.

One or more of the following practices will usually be necessary to control johnsongrass:

- Frequent mowing or pasturing for several years to weaken or partially control johnsongrass stands.
- Regular plowing or disking of fallow land before johnsongrass reaches a height of 12 to 15 inches. This practice is more effective under dry conditions than under wet conditions.
- Use of crop rotations involving mowing, plowing, disking or all three practices.
- Utilization of effective cultural procedures before treating with chemicals to reduce johnsongrass stands and also to increase herbicidal effectiveness.
- Use of a herbicide for preemergence control of johnsongrass seedlings in crops at planting even when established johnsongrass has been controlled.
- Treatment of johnsongrass escapees after crop emergence, with directed sprays of heribicides registered for this use, and employment of the most effective cultural practices available. Additional control is obtained by treating spot infestations of johnsongrass with registered treatments.
- Application of contact or translocated herbicides on noncropland throughout the growing season to prevent growth, or application of soil sterilants to provide seasonal control of johnsongrass.

USE OF PESTICIDES

This publication is intended for nationwide distribution. Pesticides are registered by the Environmental Protection Agency (EPA) for countrywide use unless otherwise indicated on the label.

The use of pesticides is governed by the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended. This Act is administered by EPA. According to the provisions of the Act "It shall be unlawful for any person to use any registered pesticide in a manner inconsistent with its labeling." (Section 12(a)(2)(G))

EPA has interpreted this Section of the Act to require that the intended use of the pesticide must be on the label of the pesticide being used or covered by a Pesticide Enforcement Policy Statement (PEPS) issued by EPA.

The optimum use of pesticides, both as to rate and frequency, may vary in different sections of the country. Users of this publication may also wish to consult their Cooperative Extension Service, State Agricultural Experiment Stations, or County Extension Agents for information applicable to their localities.

The pesticides mentioned in this publication are available in several different formulations that contain varying amounts of active ingredient. Because of this difference in active ingredient the rates given in this publication refer to the amount of active ingredient, unless otherwise indicated in the publication. Users are reminded to convert the rate in the publication to the strength of the pesticide actually being used. For example, 1 pound of active ingredient equals 2 pounds of a 50% formulation.

The user is cautioned to read and follow all directions and precautions given on the label of the pesticide formulation being used.

Federal and State regulations require registration numbers on all pesticide containers. Use only pesticides that carry one of these registration numbers.

USDA publications that contain suggestions for the use of pesticides are normally revised at 2 year intervals. If your copy is more than 2 years old, contact your Cooperative Extension Service to determine the lastest pesticide recommendations.

The pesticides mentioned in this publication were Federally registered for the use indicated as of the issue of this publication. The user is cautioned to determine the directions on the label or labeling prior to use of the pesticide.

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